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Reply to Office Action of June 20, 2003

REMARKS/ARGUMENTS

Claims 1-11 are objected to for the reason that claims 1 and 2 include awkward descriptions "to outside" and "are made to contact with," respectively. The Examiner also requested that other claims be reviewed. To eliminate the objections, these claims and others have been amended.

Claim 5 is rejected under 35 U.S.C. 112, second paragraph, as being unclear how the solution is applied with small amplitude vibration, or what applicants intend by this recitation. This is avoided as noted below.

With regard to the application of small amplitude vibration to the solution (i.e., cleaning liquid), as described at pages 17-18 of the specification, "the cleaning liquid may be applied with small-amplitude vibration caused by ultrasonic waves, for example." Thus, claim 5 has been amended to clarify that the solution has a small-amplitude vibration applied by ultrasonic waves. This is not shown or suggested by the cited art.

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Claims 1-3 and 5-11 are rejected under 35 U.S.C. 102(b) as anticipated by Ban et al. (5,246,586).

However, Ban et al discloses an apparatus and method for producing ultrapure water (e.g. see title and claims). The present invention, on the other hand, is a method for cleaning ultrapure water (which could, for example, be produced originally by the Ban et al. invention), not a method of producing ultrapure water. This is discussed in the present application "Background" at pages 1-3. The cleaning involves, e.g., removal of fine particles (see invention objects at pages 3-4 of the present application).

Typically, the cleaning method for ultrapure water serves to clean at least part of an ultrapure water supply system produced by an ultrapure water production apparatus, e.g. see Fig. 1 or Fig. 4 hereof (primary pure water 10) prior to the ultrapure water cleaning method hereof being carried out. Thus, this invention basically differs from the object of Ban et al. and accomplishes that object using a different method and apparatus.

The present invention comprises a significant feature not shown or suggested by Ban et al. that the surface potential of fine particles is changed from positive to negative so as to be

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the same polarity as that of component parts constituting system elements. This facilitates the removal of the fine particles from surfaces of the system elements.

Specifically, this cleaning method is based on a principle of removal of fine particles, that is specific to this invention and its objects, as described at pages 10-12 of the specification. This principle can be summarized as follows: Fine particles in an ultrapure water supply system 1 have positive surface potentials, whereas system elements have negative surface potentials, and therefore, by changing the surface potentials of the fine particles from positive to negative so as to be the same polarity as that of the system elements, electrostatic attractive forces produced between the fine particles and the system elements can be eliminated, or electrostatic repulsive forces can be produced therebetween.

Ban et al. do not show or suggest the cleaning method of this invention which is based on the aforementioned principle. As pointed out by the Examiner, Ban et al. disclose a pH adjustment for charging particles in an ultrapure water production apparatus by using an alkali e. g.,  $\text{NaHCO}_3$ . However, this pH adjustment using an alkali merely serves to increase the

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zeta potential of charged and neutral impurities mainly consisting of colloidal impurities or merely serves to ionize the impurities (col. 2, lines 11-17).

Specifically, in Ban et al., the alkali introduced into the pretreated water increases the pH value of the water to about 8, and the negative zeta potential of impurities is further decreased to a negative value, or the impurities are changed to negative polyvalent ions, so that they are removed as anions by means of the subsequent anion exchange resin tower 8 and the subsequent RO unit 11 (col. 4, lines 12-15, lines 24-29 and lines 32-36).

As for positively charged particles, in Ban et al. the pretreated water to which  $\text{NaHCO}_3$  is poured is passed through a cation exchange resin tower, so that the positively charged particles are adsorbed and replaced by  $\text{H}^+$  (col. 4, lines 15-19). This indicates that the positively charged particles remain as they are after an alkali, e.g.,  $\text{NaHCO}_3$  is added to the pretreated water. Ban et al. fail to disclose or suggest, at least, negatively charging the positively charged particles

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(which differ from the charged and neutral impurities mainly consisting of colloidal impurities) by pouring an alkali into the pretreated water.

In brief, Ban et al. remove, in the ultrapure water producing apparatus, the charged and neutral impurities contained in the treated water and mainly consisting of colloidal impurities by aggregating or ionizing the impurities during the ultrapure water production. Thus, it is apparent that Ban et al. do not include any descriptions suggesting the step (a) of the present invention for negatively charging the positively charged fine particles so as to be capable of being easily removed from system elements.

In order to produce ultrapure water, Ban et al. are designed to remove positively charged particles by means of a cation exchange resin 3, remove negatively charged particles by means of an anion exchange resin 9 and an RO unit 11, and remove neutral particles by means of the RO unit 11 (col. 4, lines 15-36). That is, Ban et al. remove particles by means of separate units, such as the unit 11, of an ultrapure water producing apparatus. In the present invention for cleaning an ultrapure water supply system, fine particles changed from positive to negative in

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charged state are simply discharged from the ultrapure water supply system together with cleaning liquid or ultrapure water for rinsing. In other words, the present invention does not use component units of the ultrapure water supply system in removing fine particles. It is apparent that Ban et al. do not include any description suggesting the step (b) of this invention for discharging the fine particles, changed from positive to negative in charged state, to the outside of the ultrapure water supply system together with cleaning liquid or ultrapure water for rinsing.

To be noted, Ban et al. fail to suggest not only the step (a), recited in claim 1, for changing the surface potential of fine particles into the same polarity as that of component parts constituting elements of the ultrapure water supply system by changing the surface potential of the fine particles from positive to negative (more generally, a technical concept for changing the polarity of the surface potential of fine particles in relation to that of system elements), but also a technical concept for removing fine particles from surfaces of system-elements. In this manner, Ban et al. lack any suggestions

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concerning the system cleaning method claimed in claim 1 of this application.

The above-mentioned differences clarify the difference in principle of removal of fine particles between this invention and Ban et al.

Regarding claims 3 and 5, the Examiner states that the action of pump 6 will result in "small amplitude vibration" recited in claim 5 and will constitute application of a "physical force to the fine particles" recited in claim 3. However, the pump 6 of Ban et al. merely serves to draw up pretreated water from a decarbonation tower 5 to an anion exchange resin tower 8, and does not contribute to the removal of impurities from the treated water. On the contrary, the application of a physical force and small amplitude vibration recited in claims 3 and 5 can realize removal of fine particles that cannot be realized by the drawing up of treated water by means of the pump action. Thus, claims 3 and 5 entirely differ from Ban et al. Amendments to these claims clarify the differences.

Claim 4 is rejected under U.S.C. 103(a) as being unpatentable over Ban et al., on the reasoning that the claimed range of flow velocity of 0.5 m/sec to 2.0 m/sec falls within an

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ordinary technical matter unless unexpected results or criticality of the claimed range is shown.

In this regard, referring to a flow velocity-fine particle count curve of FIG. 3 showing the number of fine particles after passing the cleaning liquid at flow velocities of 0.25, 0.75, 1.5 and 2 m/sec, the specification of this application states at page 14 to the effect that

"the cleaning effect obtained with the flow velocity 0.25 m/sec is not of satisfactorily level, and the cleaning effect does not significantly improve and becomes almost saturated at a flow velocity exceeding 2.0 m/sec, and accordingly, a preferred range of the flow velocity is considered to be 0.5 to 2.0 m/ sec."

This description clarifies that claim 4 indicates a specific flow velocity range in which a required cleaning effect can be achieved without causing an undesirably increased flow velocity, i.e., undesired energy consumption. It is apparent that the cleaning method claimed in claim 4 can achieve unexpected results. Ban et al. provides no teaching to cause one to select the claimed range.

In summary, the cleaning method claimed in claim 1 changes the surface potential of fine particles in an ultrapure water



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supply system from positive to negative so as to be changed into the same polarity as that of components parts of system elements, so that the fine particles are enabled to be easily removed, and then discharges the fine particles to the outside of the system to remove the fine particles from the system, thereby cleaning the system to an extent that it can produce ultrapure water that satisfies the required water quality. Contrary to this, Ban et al. carry out a pH adjustment to aggregate or ionize impurities in treated water used for the production of ultrapure water, and the aggregated or ionized particles are removed in the ultrapure water producing apparatus. The present invention claimed in claim 1 and relating to system cleaning entirely differs from Ban et al. relating to the production of ultrapure water.

Even though the pH adjustment disclosed in Ban et al. can be applied to system cleaning, the result is that fine particles are simply aggregated or ionized, and hence it is considered that fine particles adhered to surfaces of system elements cannot be discharged to the outside of the system. Further, a subsequent system or unit is essentially required to remove the aggregated or ionized particles.

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In claims 2-5, the ease of removing fine particles is enhanced by usage of a basic solution or a solution of surfactant, by application of physical force to the fine particles, by setting a proper flow velocity, and by application of small-amplitude vibration to the solution, respectively. Ban et al. do not contemplate removing fine particles to the outside of the system, and accordingly do not suggest the cleaning methods claimed in claims 2-5 that can achieve the easy removal of fine particles.

In claims 6-11, cleaning liquid is used that is prepared by adding base, surfactant or gas to pure water or ultrapure water. Such cleaning liquid can fully exhibit its function of changing the surface potential of fine particles such that the fine particles are enabled to be easily removed, even though the cleaning liquid has a low concentration of base or the like. Thus, an amount of residual constituent (such as base) of the cleaning liquid after cleaning the system can be reduced, making it possible to prevent the TOC of ultrapure water produced in the system from increasing and to easily remove the residual constituent of the cleaning liquid remaining in the system, as stated at page 5, lines 14-20 of the specification. Ban et al.

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do not suggest any system cleaning, and apparently lack teachings about claims 6-11 that can reduce residual cleaning liquid.

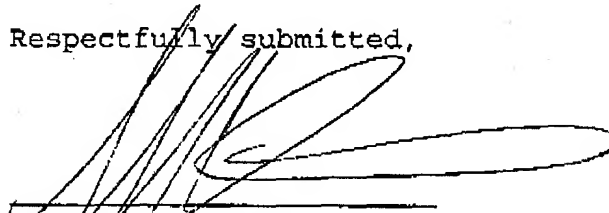
Claims 1, 2 and 5 are amended, so that formal objections to these claims are removed.

In conclusion, claims 1-12 have constructions, functions and advantages that are not disclosed or suggested by Ban et al.

Entry of this AMENDMENT and allowance of the application are respectfully requested.

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Respectfully submitted,



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